

The conservation and restoration of metal objects is an activity dedicated to the preservation and protection of objects of historical and personal value made from metal. When applied to this activity is generally undertaken by a conservator-restorer.

Historically, objects made from metal were created for religious, artistic, technical, and domestic uses. The act of conservation and restoration strives to prevent and slow the deterioration of the object as well as protecting the object for future use. The prevention and removal of surface tarnish is the primary concern of conservator-restorers when dealing with silver objects.

Precious metal that has been mined for used as early as 4000 B.C. in Anatolia Because metal is malleable and durable it has been used for many purposes which include jewelry, tableware, ornaments, coins and movie film. It is often used as a plating on other metals.

Tarnish

All metals, apart from pure gold, will corrode naturally when exposed to elements such as air. High relative humidity, moisture, and air pollutants are common causes of corrosion in metals, including silver. Silver is known in the chemistry world as a noble metal which means it is resistant to corrosion, but not completely. Whether silver plating or pure silver, the composite of the metal will tarnish when exposed to air and sulfur. Tarnish is a chemical reaction on the surface of metal (copper, brass, silver, etc.) and causes a layer of corrosion. In the case of silver tarnish, the silver combines with sulfur and forms silver sulfide which is black. The original silver surface can be restored if the layer of silver sulfide is removed. On some metals, tarnish serves as a protective layer known as a patina and is typically found on copper and bronze roofing, architectural elements, statues and bells.

Preventing interaction with sulfur gases

Sulfur-containing gases and particulates can tarnish the surface of metal. These corrosive agents can come from air pollution, paints, textiles, bacterial by-products, and other chemically treated objects or building materials.

Polishing and buffing are finishing processes for smoothing a workpiece's surface using an abrasive and a work wheel. Technically *polishing* refers to processes that use an abrasive that is glued to the work wheel, while *buffing* uses a loose abrasive applied to the work wheel. Polishing is a more aggressive process while buffing is less harsh, which leads to a smoother, brighter finish. A common misconception is that a polished surface has a mirror bright finish, however most mirror bright finishes are actually buffed.

Polishing is often used to enhance the looks of an item, prevent contamination of instruments, remove oxidation, create a reflective surface, or prevent corrosion in pipes. In metallography and metallurgy, polishing is used to create a flat, defect-free surface for examination of a metal's microstructure under a microscope. Silicon-based polishing pads or a diamond solution can be used in the polishing process.

The removal of oxidization (tarnish) from metal objects is accomplished using a metal polish or tarnish remover; this is also called polishing. To prevent further unwanted oxidization, polished metal surfaces may be coated with wax, oil, or lacquer. This is of particular concern for copper alloy products such as brass and bronze. The term chem-mechanical was coined to describe action of corrosive slurry on silicon in a

polishing process. Multiple rotating heads, each studded with silicon wafers, get forced against a large rotating buffing pad, which is bathed in corrosive slurry. Material removal at elevated temperature progresses first through oxidation, then through oxide removal by abrasion. This cycle repeats with each rotation of a head. Potassium Hydroxide and Silox (white paint-base) can be combined with deionized water to form such a slurry.

Process

The first stage starts with a rough abrasive and each subsequent stage uses a finer abrasive until the desired finish is achieved. The rough pass removes surface defects like pits, nicks, lines and scratches. The finer abrasives leave very thin lines that are not visible to the naked eye. Lubricants like wax and kerosene may be used as lubricating and cooling media during these operations, although some polishing materials are specifically designed to be used "dry." Buffing may be done by hand with a stationary polisher or die grinder, or it may be automated using specialized equipment.

When buffing there are two types of buffing motions: the *cut motion* and the *color motion*. The cut motion is designed to give a uniform, smooth, semi-bright surface finish. This is achieved by moving the workpiece against the rotation of the buffing wheel, while using medium to hard pressure. The color motion gives a clean, bright, shiny surface finish. This is achieved by moving the workpiece with the rotation of the buffing wheel, while using medium to light pressure.

When polishing brass, there are often minute marks in the metal caused by impurities. To overcome this, the surface is polished with a very fine (600) grit, copper plated, then buffed to a mirror finish with an airflow mop.[*citation needed*]

Polishing operations for items such as chisels, hammers, screwdrivers, wrenches, etc., are given a fine finish but not plated. In order to achieve this finish four operations are required: roughing, dry fining, greasing, and coloring. Note that roughing is usually done on a solid grinding wheel and for an extra fine polish the greasing operation may be broken up into two operations: rough greasing and fine greasing. However, for inexpensive items money is saved by only performing the first two operations.

Polishing knives and cutlery is known as fine glazing or blue glazing. Sand buffing, when used on German silver, white metal, etc., is technically a buffing operation because it uses a loose abrasive, but removes a significant amount of material, like polishing.

Equipment

Aluminium oxide abrasives are used on high tensile strength metals, such as carbon and alloy steel, tough iron, and nonferrous alloys. Silicon carbide abrasives are used on hard and brittle substances, such as grey iron and cemented carbide, and low tensile strength metals, such as brass, aluminium, and copper.

Polishing wheels come in a wide variety of types to fulfill a wide range of needs. The most common materials used for polishing wheels are wood, leather, canvas, cotton cloth, plastic, felt, paper, sheepskin, impregnated rubber, canvas composition, and wool; leather and canvas are the most common. Wooden wheels have emery or other abrasives glued onto them and are used to polish flat surfaces and maintained good edges. There are many types of cloth wheels. Cloth wheels that are cemented together are very hard and used for

rough work, whereas other cloth wheels that are sewn and glued together are not as aggressive. There are cloth wheels that are not glued or cemented, instead these are sewed and have metal side plates for support. Solid felt wheels are popular for fine finishes. Hard roughing wheels can be made by cementing together strawboard paper disks. Softer paper wheels are made from felt paper. Most wheels are run at approximately 7500 surface feet per minute (SFM), however muslin, felt and leather wheels are usually run at 4000 SFM.

Buffing wheels, also known as mops, are either made from cotton or wool cloth and come bleached or unbleached. Specific types include: sisal, spiral sewn, loose cotton, canton flannel, domet flannel, denim, treated spiral sewn, cushion, treated vented, untreated vented, string buff, finger buff, sisal rope, mushroom, facer, tampered, scrubbing mushroom, hourglass buff, rag, "B", climax, swansdown, airflow, coolair, and bullet.

Lacquering

is the process of creating a hard durable finish on the surface of an object such as wood or metal. Polished silver is sometimes lacquered to protect against tarnish and to prevent over-polishing. There are different types of resins that are used such as Acryloid B-72 and Incralac. If silver pieces are being displayed in the open, such as in a house or museum exhibit case, it is difficult to prevent corrosion from air exposure. A surface coating will prevent or slow tarnishing and is a service done by professionals or conservator. One of the most used coatings is Agateen.

Lacquer is applied to a surface that has been cleaned with ethanol, acetone, or methyl ethyl ketone. Oils from human hands prevent the lacquer from adhering to the silver. Agateen No. 27 (cellulose nitrate) and Paraloid B-72 are the most commonly used lacquers however there is a debate which lacquer, cellulose nitrate or acrylic, is best.